

DEPARTMENT OF THE INTERIOR  
U. S. GEOLOGICAL SURVEY

## **A SIX-CHANNEL SEISMIC AMPLIFIER**

by

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Open-File Report 90-346

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Appendix A contains copies of photographic films and fabrication drawings used for production of the printed circuit board described herein. The duplicate films and drawings may be obtained for reproduction of the printed circuit board. They are available from the U. S. Geological Survey, Books and Open Files, Denver, CO 80225.

## 1. Introduction

This report describes a basic six-channel instrumentation amplifier circuit board that the USGS has designed and used for amplification of seismic signals. It provides the circuit description, schematic and the list of parts needed to construct it. Any interested person may borrow and duplicate the printed circuit board films (Appendix A) for making this amplifier. However, no warranty, expressed or implied, is made by the USGS as to the accuracy and functioning of the amplifier. Nor shall the fact of distribution constitute any such warranty, and no responsibility is assumed by the USGS in connection therewith.

## 2. Description

This circuit board was designed to be part of a system for amplifying, filtering and digitizing a large number of seismic channels. Each circuit board has six independent amplifier channels. Each channel has a gain setting which can be changed to 0, 20, 40, 60 or 80 dB by moving a jumper. It uses a monolithic integrated circuit instrumentation amplifier which can realize a noise figure (referred to input) of less than 1 microvolt peak-to-peak at high gain. The gain setting resistors used follow the recommendation of the manufacturer (Precision Monolithics Inc. Linear and Conversion Products 1986/1987 Data Book).

Refer to the parts list in Table 1 for an explanation of the part numbers used here. Also, see the circuit diagram in Figure 1. Solder terminals are mounted at Rx01, Rx02 and Rx03 to permit adding or changing damping resistors for use with seismometers. If no damping is desired, Rx01 and Rx02 can be shorted with wire. Rx05 and Rx06 provide input overvoltage protection in conjunction with diodes CRx01 and CRx02. They also work with Cx01 and Cx02 to filter high frequency noise out. It is very important that Cx01 and Cx02 be matched as closely as possible in capacitance (i.e. < 1%) to maintain low noise. Rx04 and Rx07 provide a finite input impedance and stable operation with no input.

Resistors Rx08 through Rx11 set the amplifier gain from 0 to 60 dB. With no jumpers installed Rx11 is connected yielding a gain of 1 (0 dB). Installing a jumper at JPx01 connects Rx08 in parallel with Rx11 for a gain of 10 (20 dB). Similarly, moving the jumper to JPx02 parallels Rx09 for a gain of 100 (40 dB) and JPx03 parallels Rx10 for a gain of 1000 (60 dB). No more than one of these jumpers should be installed at a time. Rx12 sets the scale factor for 0 to 60 dB. A jumper is normally installed at JPx04 to short Rx13. When a gain of 10,000 (80 dB) is needed, this jumper is removed adding Rx13 in series with Rx12. This should only be done when the 60 dB jumper (JPx03) is also installed. See Table 2 for proper jumper settings.

Potentiometer Rx14 is an input offset adjustment. It should be adjusted to produce zero volts output with the input shunted with a normal operating impedance. Capacitors C1, C2, Cx03 and Cx04 are power supply filtering devices. The board can be powered with +/-5 to +/-18 volts on pins 2 and 4 of the edge connector. Current consumption is typically 3 milliamps per side per amplifier channel. Additional information on specifications is available in the Precision Monolithics Data Book.

Table 1

**PARTS LIST**

There are six identical amplifier circuits in this circuit board. The part numbers of all the components of a single amplifier circuit have the same number in the hundreds digit. That is amplifier channel 1 has part numbers in the 100's and channel number 6 has part number in the 600's. The corresponding parts of each amplifier have part numbers with the same value disregarding the hundreds digit. Therefore resistor R104 on channel 1 corresponds to R604 on channel 6. The letter "x" in the following part numbers represents the hundreds digit of each of the six channels and can have a value of 1 to 6. C1 and C2 are not associated with one particular channel and so do not have a hundreds digit. For each channel Cx01 and Cx02 must be selected to have capacitance as closely matched to each other as possible in order to maximize common mode rejection and minimize noise.

<u>Part #</u>	<u>Description</u>	<u>Qty.</u>
C1,C2	15 uf 20 VDC dipped tantalum	2
Cx01,Cx02	.22 uf Dip Ceramic X7R temp. (see text)	12
Cx03,Cx04	.01 uf Dip Ceramic	12
CRx01,CRx02	1N914	12
Rx04,Rx07	100 ohm      1/4 watt      5%	12
Rx05,Rx06	1 M            1/4 watt      5%	12
Rx08	22.1 K        1/8 watt      1%	6
Rx09	2.0 K          1/8 watt      1%	6
Rx10	200 ohm       1/8 watt      1%	6
Rx11	200 K          1/8 watt      1%	6
Rx12	10 K           1/8 watt      1%	6
Rx13	90.9 K        1/8 watt      1%	6
Rx14	Bourns 32962-1-104 100K Potentiometer	6
Ux01	PMI AMP-01-BX Instrumentation Amplifier	6
Misc.	18-pin IC socket	6
	6-pin inline jumper strips	6
	2-pin inline jumper strips	6
	Closed shorting jumper	12
	USECO 2003 B-1 terminals(Rx01,02,03 if needed)	36
	Damping resistors                      (Rx01,02,03 if needed)	18
	Bufferfly P.C. card ejectors	2

Table 2

Jumper Settings

Gain	JPx01	JPx02	JPx03	JPx04
0 dB				X
20 dB	X			X
40 dB		X		X
60 dB			X	X
80 dB			X	

X = jumper installed, blank = no jumper

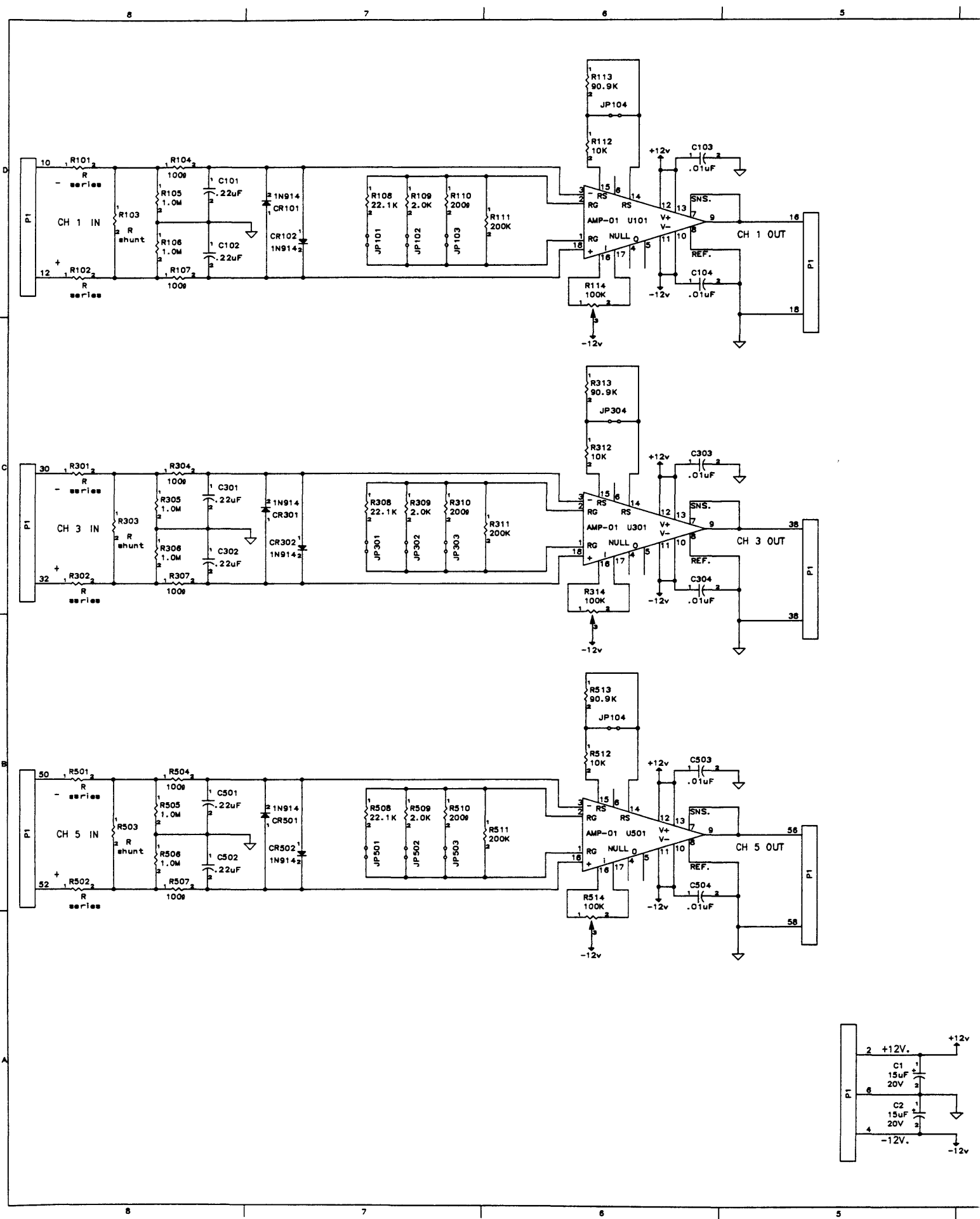
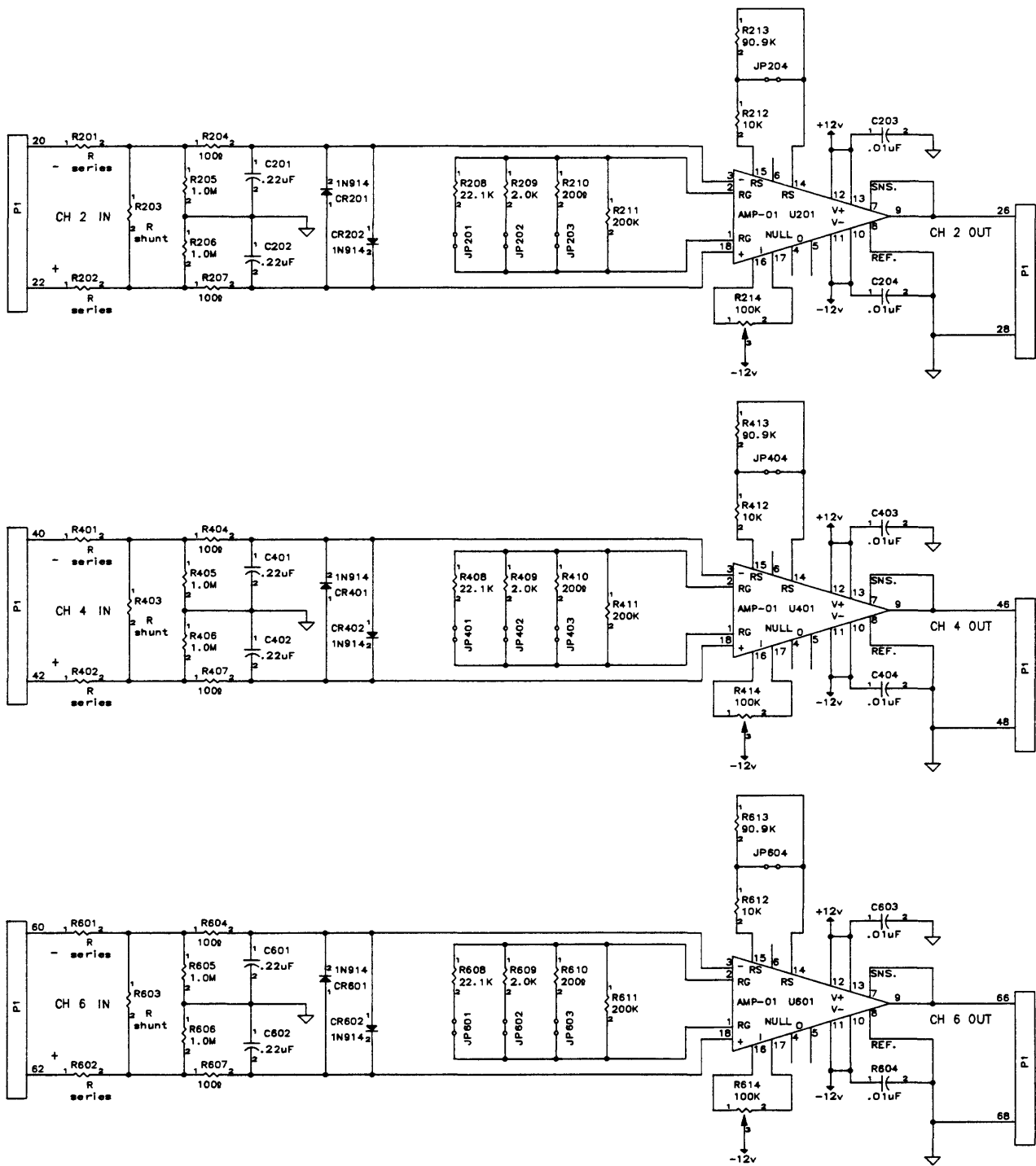


FIGURE 1 (left half) - 6 -



U.S. Geological Survey, O.E.V.E. 345 Middlefield Rd. Menlo Park CA 94025			
TITLE SIX CHANNEL DOWNHOLE AMPLIFIER			SIZE D
FILE NAME 6ch-amp	REF. NUMBER	PAGE 1 OF 1	REV A
DATE 10/08/1987	DWG. BY E. G. JENSEN		
DATE 05/06/1990	REV. BY E. G. JENSEN		

FIGURE 1 (right half) - 7 -

**Appendix A**  
for  
**A Six-Channel Seismic Amplifier**  
**Open-File Report #90-346**

**Contents:**

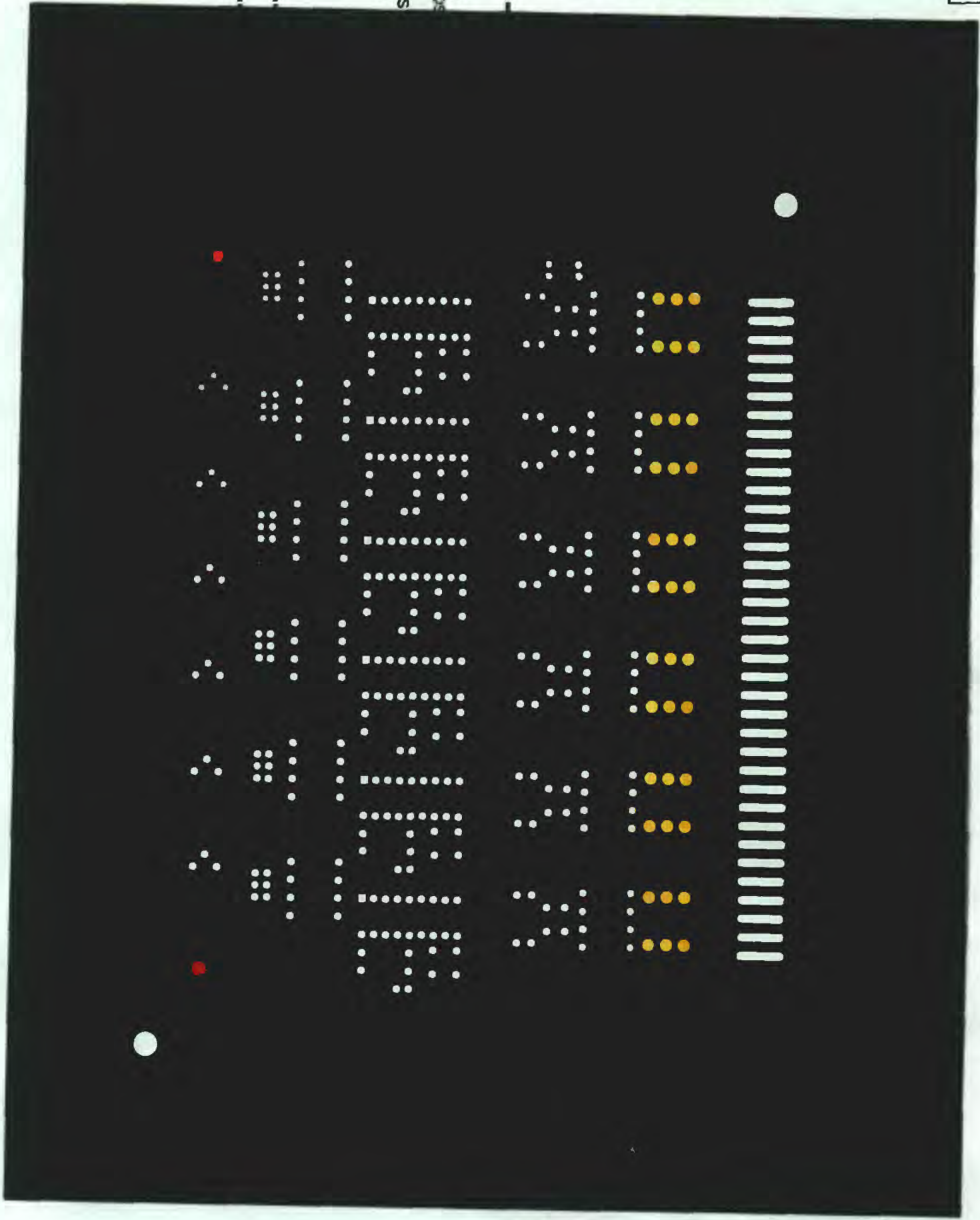
**Five printed circuit board  
photographic films**

**Two printed circuit board  
fabrication drawings**



1 2 3 4 5 6 7 8

D C B A



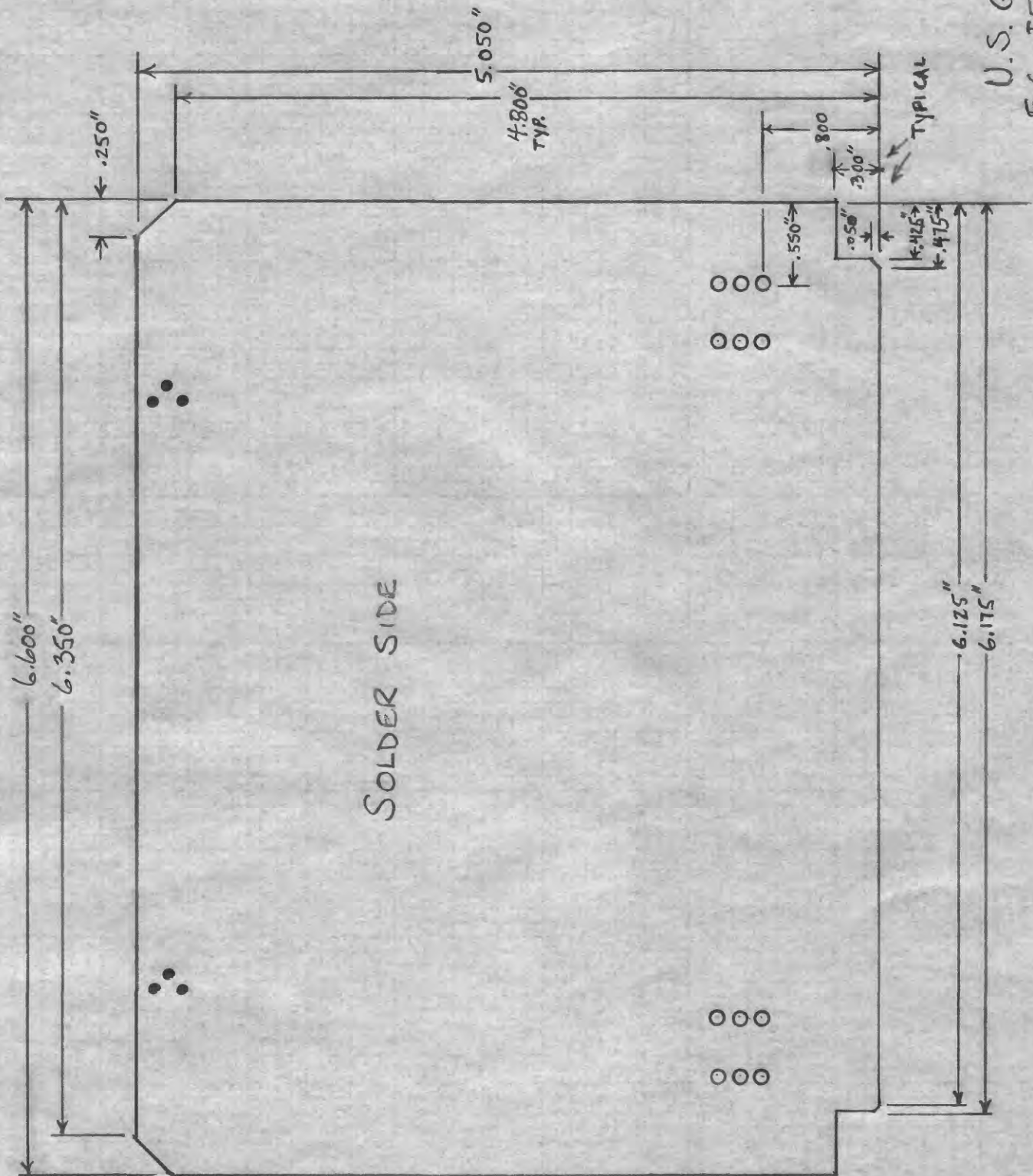
MATERIAL	
TYPE:	EPOXY GLASS
GRADE:	FR-4
THICKNESS:	.062 IN.
COLOR:	NATURAL
CLAD:	2 SIDE
COPPER WT.:	2 OZ.
SOLDER MASK:	GREEN, BOTH SIDES
LEGEND:	WHITE, COMP. SIDE
SOLDER PLATE:	40% Pb/ 60% Sn
GOLD PLATE:	.00003 IN.(FINGERS)
CHAMFER:	45 DEG.x .015 IN. (ON FINGERS)

DRILLING SCHEDULE		
CODE	HOLE SIZE	QTY
A <b>Red</b>	.100 IN.	2
B <b>Yel</b>	.065 IN.	36
ALL OTHERS	.031 IN.	391

ALL HOLES PLATED THRU  
WITH MIN. .0014 IN. COPPER  
THICKNESS

U.S. Geological Survey, O.E.V.E. 345 Middlefield Rd. Menlo Park CA 94025			
TITLE	GEOS A/D ADAPTER BD. FABRICATION DRAWING	SIZE	B
FILE NAME	REF. NUMBER	PAGE	REV
FABTITL	000000	1 OF 1	A
DATE	03/27/1985	DWG. BY	E. G. JENSEN
DATE		REV. BY	

2 3 4 5 6 7 8



U.S.G.S.  
E.G. JENSEN  
(415) 329-4729  
JULY 1, 1990

6-CHANNEL AMPLIFIER BOARD  
FABRICATION DRAWING 2 OF 2

CHAMFER  
FINGERS  
45° x .015"